

## COVID-19 pandemic and lacrimal practice: Multipronged resumption strategies and getting back on our feet

Mohammad Javed Ali

The aim of this review was to propose multi-pronged resumption strategies for lacrimal practice in an effort to plan a sustainable recommencement of elective surgeries after we emerge from the peak of COVID-19 pandemic. The strategies for lacrimal practice were classified into 7 subtypes, and each of the blueprints were reassessed based on existing information on resumption strategies of elective surgeries from other specialties in COVID-19 era. The specific needs of lacrimal practice were then added to construct algorithms summarizing the resumption strategies. The basic principle of 'primum non nocere' needs to be followed. The overall proposed plan advocates the transition to a more sustainable health care reality in a world where we would still co-exist with COVID-19. A comprehensive effort involving screening, laboratory testing, appropriate triage, effective personal protection and specific precautionary measures for lacrimal clinics and operating room are needed to be able to safely resume elective surgery when the pandemic peak declines. To predict the timing of the resumption of elective surgeries is quite complex and influenced by several geographic, political and economic factors. It is equally important to remember that COVID-19 crisis is a dynamic situation and constantly evolving, hence the strategies provided are subject to change. Strict adherence to standard COVID-19 guidelines combined with effective testing and personal protection strategies can ensure slow yet smooth and safe return to full lacrimal practice after the COVID-19 pandemic calms down. The local government directives, individual and institutional discretion are advised.

**Key words:** 2019-nCoV, COVID-19, DCR, endoscopy, lacrimal, nasolacrimal duct, personal protective equipment, SARS-CoV-2

COVID-19 is a highly infectious zoonoses caused by SARS-CoV-2 virus and is an incredible threat to global health.<sup>[1]</sup> The economic loss to health care facilities is often overlooked in times of a pandemic with serious consequences.<sup>[2]</sup> The American Hospital Association estimates a financial loss of \$202.6 billion (March through June 2020) resulting from loss of hospital and health system revenues and COVID-19 expenses.<sup>[3]</sup> This means an average loss of \$50 billion dollars a month in US alone, with an unimaginable impact on overall global health systems. Hence, a safe, gradual and smooth return to practice in the immediate aftermath of a dwindled COVID-19 pandemic is crucial. Several countries are now experiencing flattening of the epidemiological curve as assessed by reduction in the number of infections, hospitalizations and virus-related mortalities. Therefore, there is a need for developing resumption strategies, improvising them based on emerging evidence and be ready to implement them when the time arrives.

The nasal tissues have demonstrated shedding of SARS-CoV-2 virus and nasal interventions are potential aerosol generators.<sup>[4,5]</sup> This greatly enhances the risk of viral exposure from droplets or aerosols for the lacrimal surgeons and their staff.<sup>[6]</sup> This risk can be compounded by the face to face position with the patients during examinations or surgery, possible sneezing and coughing that can be induced by the

Govindram Seksaria Institute of Dacryology, L.V. Prasad Eye Institute, Hyderabad, Telangana, India

**Correspondence to:** Prof. Mohammad Javed Ali, L.V. Prasad Eye Institute, Road No 2, Banjara Hills, Hyderabad - 500 034, Telangana, India. E-mail: drjaved007@gmail.com

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procedures and the ability of the corona virus to survive on multiple surfaces for hours.<sup>[7,8]</sup>

The present paper provides an overview of specific risks and mitigation strategies for lacrimal procedures and proposes multipronged practice resumption blueprints to the best of the author's understanding of the current evidence. The proposed resumption strategies were designed to be comprehensive, not limited to pure clinical care, but to include tele-medicine, psychosocial well-being of staff and continuation of educational and research activities. In essence, the overall plan advocates the transition to a more sustainable health care reality in a world where we would still co-exist with COVID-19 and proposes efforts for a gradual yet complete and safe restart of the lacrimal practice. It is equally important to remember that COVID-19 crisis is a dynamic situation and constantly evolving, hence the strategies provided are also subject to change.

## Methods

A thorough literature search was performed on PubMed of articles published in English language on COVID-19. Search included a combination of the following words 'COVID-19',

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'SARS-CoV-2', 'pandemic', 'corona', 'virus', 'guidelines', 'surgery', 'elective', 'resumption', 'telemedicine', 'tele consult', 'economy', 'operating', 'emergency', 'urgency', 'routine', 'screening', 'triage', 'post-COVID-19', 'future', 'healthcare', 'workers', 'professional', 'clinics', 'ophthalmology', 'otolaryngology', 'oculoplastic', 'lacrimal', 'personal protective equipment', 'mask', 'face shield', 'respirator', 'endoscopy', 'laboratory diagnosis', 'testing', 'disinfection', 'sterilization', 'financial loss', 'hospital', 'transmission', 'treatment', 'education', and 'research'. Pertinent cross references were obtained from the studies. In addition, the guidelines of various societies across specialties (ophthalmology, otorhinolaryngology, endoscopy societies) having a bearing on lacrimal practice were studied. The strategies for lacrimal practice were then classified into 7 subtypes and each of the blueprints were reassessed based on existing information on COVID-19. General guidelines which could be adapted to lacrimal practice were also considered. The specific needs of lacrimal practice were then added to construct algorithms summarizing the resumption strategies.

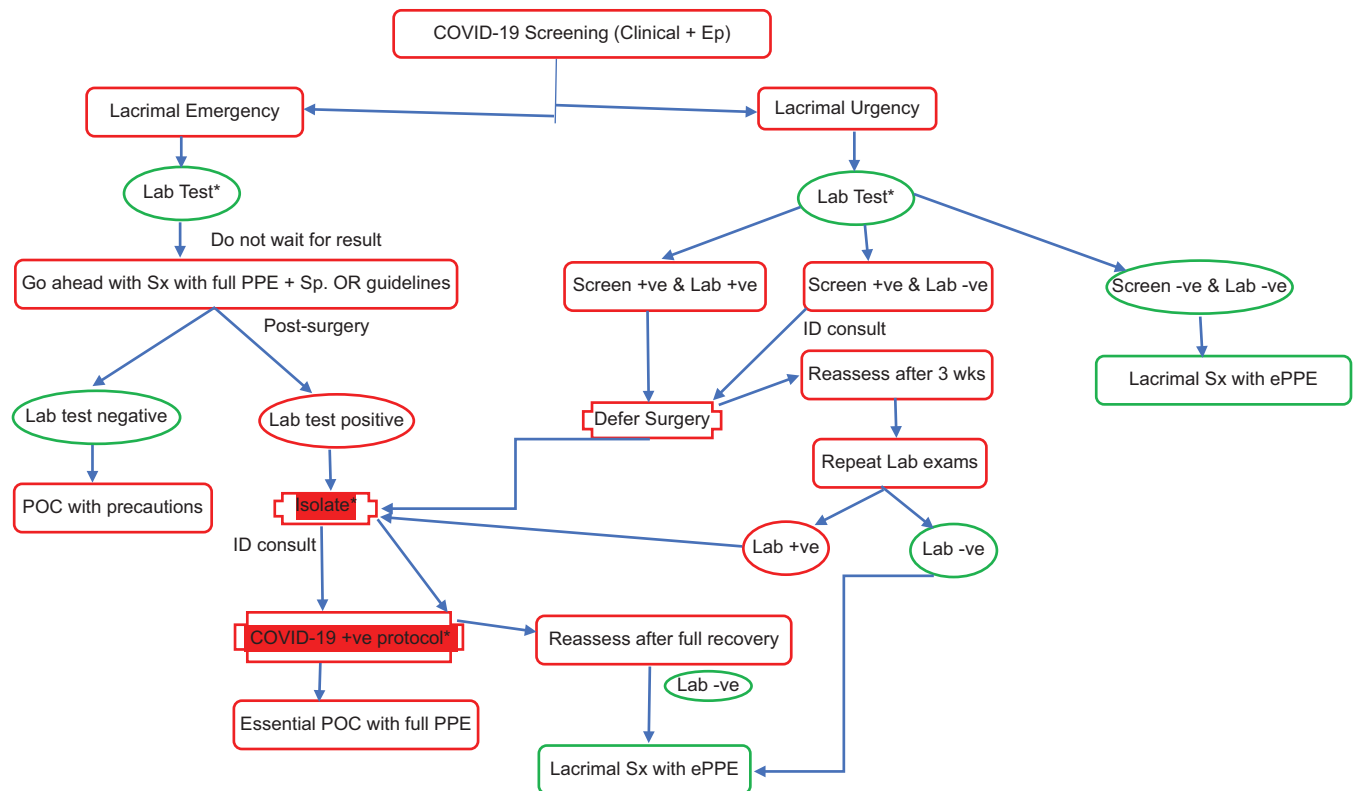
**Results**

The resumption strategies could be divided into 7 broad categories. Each category is adapted for the specific needs of the lacrimal practice and provides an overview of each of the proposed measures. Graphs 1 and 2 depict the constructed algorithms for ensuring a safe return to full lacrimal practice. Table 1 summarizes the triage strategy, while Table 2 enumerates in detail the functional, surgical and post-operative measures

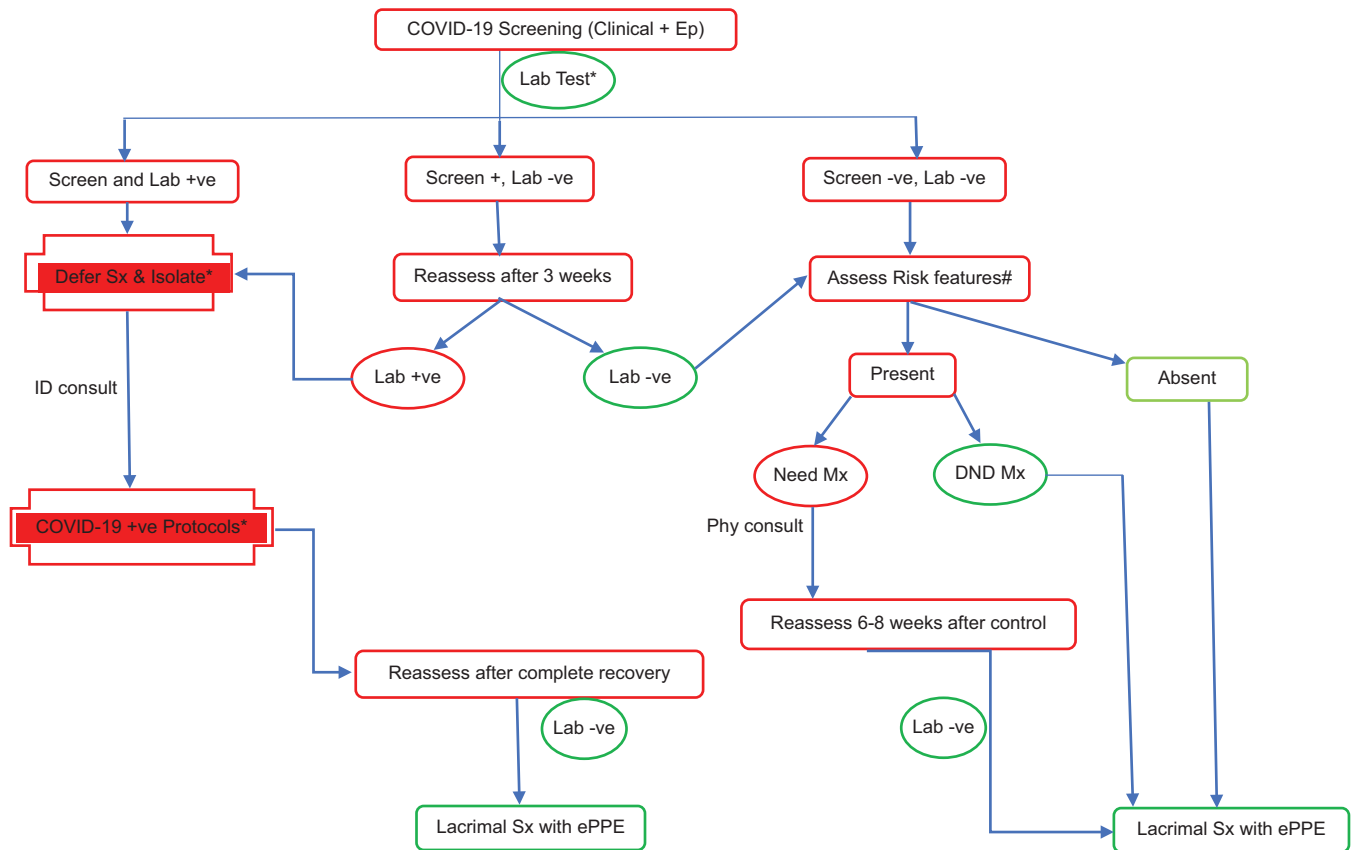
for a lacrimal specific operating room. These strategies are by no means exhaustive, and would develop and unfold more as the time and information changes.

**The Screening and Triage Strategy**

A multi-tiered screening and triage of the patients is probably the most important initial step for patients with lacrimal disorders seeking medical care as the world emerges from the peak of COVID-19.<sup>[9]</sup> A simple clinical screening at the point of care would assess brief history (occupation, geographical location, travel history, contact with suspected COVID-19 case), along with presence of clinical symptoms of fever, cough, shortness of breath or diarrhea, currently or in the immediate past. A pre-examination triage screening document can help in this effort. The screening is also extended to the accompanying person. This gives the physician a broad idea of the level of risk and whether one is dealing with a suspected or an active case, although asymptomatic carriers may escape detection.<sup>[10]</sup> Once we emerge from the peak of the COVID-19 era, the allocation of resources would become an important issue and hence a clinical triage that determines the nature of the lacrimal disorder and specific needs of the patients is desirable. The triage of indications for lacrimal disorders as emergency, urgency (can be deferred for up to 3-4 weeks with or without conservative management) and elective, even though arbitrary, can be helpful for the lacrimal surgeons. Table 1 summarizes these indications, which are by no means an exhaustive list, and can itself be a subject of debate. Therefore, individual and institutional discretion based on local government guidelines is advised. Patients should be clearly



**Graph 1:** Algorithm 1: Post-COVID-19 resumption blueprint for emergency and urgent lacrimal procedures. Ep – epidemiological; Lab – laboratory; \*procedures based on local government guidelines combined with individual and institutional discretion; Sx – surgery; PPE- personal protective equipment; Sp.OR – specific operating room; ID – infectious disease; POC – post-operative care; +ve – positive; -ve – negative; ePPE – enhanced PPE



**Graph 2:** Algorithm 2: Post-COVID-19 resumption blueprint for elective lacrimal procedures. Ep – epidemiological; Lab – laboratory; \*procedures based on local government guidelines combined with individual and institutional discretion; Sx – surgery; PPE- personal protective equipment; ID – infectious disease; +ve – positive; -ve – negative; ePPE – enhanced PPE; # - uncontrolled hypertension, diabetes, immunosuppressed; COPD; Phy – physician; ; DND - Does not need management

communicated the reason for their allocation to a particular group or decisions to defer their exams or surgical procedures. They should also receive such decisions in writing to avoid medico-legal issues or lawsuits.

### The Testing Strategy

This is one of the most significant strategy going forward in case if the resumption of urgent or elective surgeries are contemplated. There is no single gold standard test yet and outcomes are influenced by sampling techniques, sampling timing, changing viral loads, sensitivity and specificity of each test.<sup>[11-13]</sup> In addition, the kind of test employed also depends on local government guidelines and availability. Hence a negative test does not rule out infection.

Several modalities for COVID-19 testing are available in clinical use and include reverse transcriptase-polymerase chain reaction (RT-PCR) of the nasopharyngeal or oropharyngeal swabs, isothermal nucleic acid amplification tests (iNAAT), clustered regularly interspaced short palindromic repeat (CRISPR) assays, enzyme-linked immunosorbent assay (ELISA) and lateral flow immunoassays (LFA).<sup>[11-15]</sup> Each of these tests have their unique advantages and limitations; for example, RT-PCR has high sensitivity whereas iNAAT and CRISPR have high specificity.<sup>[14]</sup> LFA combines IgM and IgG antibodies in a simple single test with a sensitivity of 89% and specificity of 91% and can yield results in 15 minutes.<sup>[14,15]</sup>

While some proposed a PCR test to be economical and an effective preventive strategy in resuming an endoscopic practice,<sup>[12]</sup> others proposed only simple antibody tests as a rapid and practical alternative and PCR, if IgG was positive.<sup>[16]</sup> Currently it appears that a combination of tests would be a preferred option along with inputs from an infectious disease consult. The scarcity of testing kits due to high demand is unlikely to stay the same in the immediate aftermath of dwindled COVID-19 (timeline for currently proposed blueprints), where its access to patients getting operated will become a priority and hence is likely to have better availability.

### The Personal Protection Strategy

Personal protection strategies cannot be overemphasized more during COVID-19 pandemic, and is probably one of the most effective approaches for the safety of healthcare workers. The high risk of aerosol generation and virus transmission during nasal interventions is now known<sup>[17-21]</sup> and hence, endoscopic lacrimal procedures mandate the need of personal protection for the lacrimal surgeons and their staff.<sup>[6]</sup> The WHO estimates the global monthly needs to be approximately 89 million medical masks, 76 million gloves and 30 million gowns.<sup>[22]</sup> The massive supply chain disruptions, high demand, delayed release of pandemic stocks and confusion with regards to PPE due to evolving guidelines are adding to the woes.<sup>[23]</sup> However, the silver lining is that the efforts to manufacture PPE have also impressively scaled up as much as innovative

**Table 1: Triage of Indications for lacrimal procedures**

Emergency	Urgency	Elective
Congenital Dacryocystocele with airway compromise	Inflammatory secondarily acquired nasolacrimal duct obstruction (SALDO) with exacerbations (ex - autoimmune disorders)	Routine Primary Acquired Nasolacrimal Duct Obstruction (PANDO)
Acute dacryocystitis and lacrimal abscess	Infectious canaliculitis	Routine CNLDO
Acute lacrimal drainage trauma (canalicular lacerations, NLD injury in complex facial trauma)	Biopsy proven benign lacrimal sac mass	Canalicular obstructions
Lacrimal Sac Malignancy (biopsy proven or suspected) including locally advanced disease with features of orbital or intranasal extension.	Extubation for stent-related complications.	Functional Epiphora
	Idiopathic canalicular inflammatory disease (ICID)	Punctal stenosis
	Lacrimal sac diverticulitis	

**Table 2: Operating room blueprint for lacrimal procedures****Operating Room Functional measures**

- Negative pressure operating rooms with high efficiency particulate air filters
- Dedicated Isolation ward
- Standard OR Asepsis protocols with additional cleaning of all surfaces
- Standard sterilization of Endoscopes and Instruments
- Same day pre-operative admission (not a day before)
- Inform the OR in advance before shifting the patient
- Separate or dedicated ways to enter and exit lacrimal OR
- Patient must wear mask all the times except during GA or nasal interventions
- Prefer Local anaesthesia where possible
- COVID-19 anaesthesia protocols for all GA patients
- Minimize the number of OR staff to essential. Avoid observers.
- PPE for all the OR staff
- Social distancing between all the personnel in the OR
- Greater time spacing between surgeries

**Surgical measures**

- Peri-operative povidone Iodine for nasal and oral mucosa
- Avoid atomizers/sprays - use pellets for decongestion
- Avoid radiofrequency-assisted incisions. Prefer cold steel
- Minimize the use of cautery
- Minimize the use of suction in the nasal cavity or within wounds.
- Minimize the time needed for surgery. Avoid unnecessary delays.
- Detailed documentation in medical records
- Careful disposal of contaminated disposables

**Post-operative measures**

- Positive or Suspected COVID-19 patients to be shifted for Isolation and Quarantine
- Minimize post-operative hospital admission for COVID-19-negative patients
- Defer unnecessary post-operative visits
- Maintain good post-operative analgesia following DCR procedures
- Enhanced PPE during post-operative care
- Precautions while removing nasal pack or dealing with post-operative epistaxis
- Clear communication on discharge instruction- both oral and written
- Post-operative telemedicine or remote consults are encouraged.

solutions.<sup>[23]</sup> Hence, the situation is likely to improve greatly in the immediate aftermath of a dwindled COVID-19 pandemic, the core-context of the timeline dealt in the current study proposals.

There are quite a few variations in the personal protective equipment (PPE) based on the degree of protection, type of threat and manufacturer's recommendations.<sup>[23]</sup> For the purpose of lacrimal surgeries, the author has arbitrarily considered two variants, erring on the side of higher protection – enhanced PPE and full PPE. The components of each are as follows:

**Enhanced PPE:** Regular scrubs + full sleeve fluid repellent surgical gown + impervious surgical head cap + N-95/FFP3 respirator + goggles/visor with full face shield + double surgical gloves + boot cover.

**Full PPE:** Fluid repellent/disposable scrubs + Coverall/impervious full sleeve surgical gown with hairnet and hood cover + N-95/FFP3 respirator or positive air purifying respirator (PAPR) + goggles/visor, FFP3 respirator with face shield (if no access to PAPR) + double surgical gloves + boot cover.

The use of either enhanced or full PPE depends on the type of procedure and the COVID-19 status of the patient [Algorithms in Graphs 1 and 2].<sup>[6]</sup> There are guidelines for donning and doffing of PPE and must be strictly adhered to, failing which may increase the transmission risk.<sup>[20,21,24]</sup>

**The Lacrimal Clinics and Operating Room Strategy**

There are growing voices across many surgical specialties on safe and effective resumption of elective procedures after the COVID-19 calms down and the author joins them with a proposal for lacrimal procedures.<sup>[25-28]</sup> Once the pandemic declines, institutional and individual practices would come under enormous pressure to scale up their elective procedures to cater to the needs of many waiting patients as well as for meeting the financial needs. Hence, the resumption of lacrimal practice needs planning which would include chalking out expected patient demand so that the systems can plan better utilization of staff and resources. There would also be a need to reconsider value added procedures like image-guided dacryolocalization and three-dimensional endoscopy.<sup>[29,30]</sup> These procedures may not be very essential during the COVID-19 times and can be avoided, unless really needed. Negotiating with all our vendors on getting the cost of recurrent and expensive consumables like powered drills and certain stents would be helpful for financial stability. Furthermore, the patient must understand the risks of undergoing elective procedures even after we emerge out of the COVID-19 peak and there should be an additional written consent in this regard.

The lacrimal clinical examination and surgeries are unique because of the proximity with the patient and the risks of aerosol generation and virus transmission. The two common

clinical examinations performed are lacrimal irrigation and nasal endoscopy which would need a further elaboration in the context of COVID-19 pandemic. The presence of SARS-CoV-2 virus in the tears is heavily debated.<sup>[30,31]</sup> The risk is enhanced due to the potential risk of aerosol generation during lacrimal irrigation, especially in those with lacrimal drainage obstructions. In the immediate aftermath of dwindled COVID-19, lacrimal irrigation can be performed with enhanced PPE, preferably using a straight 25- or 27-gauge cannulas mounted on a low volume syringe like a 1 cc. This would reduce the force to push the fluid and subsequent aerosol generation.<sup>[6]</sup> The straight canula can also be used to assess the level of canalicular stenosis or obstruction simultaneously without the need for a second intervention with a separate probe.

Nasal endoscopy and dacryoendoscopy are used for both diagnostic and therapeutic indications in lacrimal drainage disorders. The risk of aerosol generation and nasal intervention has restricted its routine use during the COVID-19 pandemic.<sup>[4,5]</sup> However, as we emerge after the peak of the pandemic, its use would be justified for even elective surgeries provided certain precautions are taken.<sup>[32]</sup> The use of enhanced PPE and pediatric (small diameter) endoscopes are encouraged since there is a potential for the patient to sneeze or cough during the procedure.<sup>[33]</sup> The use of decongestant or local anesthetics in sprays or atomizers is controversial and medicated pledgets appear logical.<sup>[33]</sup> The SARS-CoV-2 virus is known to stay on surfaces for prolonged durations.<sup>[7,8]</sup> Hence, standard sterilization of endoscopes and instruments are advised. Furthermore, the appointments for lacrimal clinic examinations must be spaced so that it provides adequate time to clean all the surfaces in the procedure room.

Elective lacrimal surgeries not only form a chunk of oculoplastic procedures but also are considered high risk intervention during the COVID-19 pandemic and were stopped. Hence, their resumption in the immediate aftermath of the dwindled pandemic deserves attention to reduce patient morbidity and minimize further healthcare financial loss. To achieve this objective, optimal infection control and special operating room management are required. Table 2 lists out a 3-fold strategy for lacrimal surgeries; functional, surgical and post-operative measures. The broad general measures include negative pressure operating rooms (OR) rooms with high efficiency particulate air (HEPA) filters,<sup>[34]</sup> strict OR asepsis and sterilization of endoscopes and instruments, dedicated entry and exit points of an OR and effective PPE and social distancing.

The use of powered instruments like endoscopic drills, ultrasonic burrs, radiofrequency, and electrocautery is being avoided or restricted to minimum since any respiratory mucosal manipulation by these may have the potential to aerosolize the virus which becomes airborne for several hours and may contaminate several surfaces in the operating room, thereby risking the operating room staff.<sup>[7,35]</sup> The classic example of such transmission is that of the endoscopic endonasal pituitary procedure in Wuhan, where 14 personnel got infected following the surgery.<sup>[36]</sup> This brings us to the possible peri-operative use of povidone iodine (PVP-I) during lacrimal surgeries. PVP-I is a widely used agent for pre-operative skin and oral mucosa preparation and also has a broad spectrum of bactericidal and

viricidal effects.<sup>[37]</sup> Studies have also demonstrated its efficacy against corona viruses.<sup>[38-39]</sup> A PVP-I concentration of 0.4 to 0.5% has been recommended for peri-operative irrigation of sino-nasal and oral mucosa.<sup>[40]</sup> There is now growing evidence for its use during COVID-19 to reduce surgery induced viral shedding and aerosolization, especially in head and neck surgeries.<sup>[40-42]</sup> A detailed protocol for the use of PVP-I in lacrimal surgeries is now in place<sup>[43]</sup> and in use at the author's practice. This protocol would mitigate the transmission risk of the viruses during the lacrimal procedures in both pediatric and adult populations.

### The Telemedicine Strategy

Telemedicine utilizes remote evaluation by the physicians to diagnose and manage certain medical conditions. It has been employed for afterhours medical admission and disaster management.<sup>[44]</sup> The modalities employed are video visits, telephone encounters, meeting platforms and tele-medicine enabled slit lamps at remote locations.<sup>[45-48]</sup> COVID-19 pandemic has offered a unique opportunity to physicians worldwide to explore this possibility. There are several advantages of telehealth use during a pandemic which includes reduced risk of virus exposure to both the provider and the patient, reduced need for healthcare resources, reduced patient morbidity through appropriate advices and transmission of clear instructional videos and patient satisfaction.<sup>[45-49]</sup> There are several limitations as well and include potential for medical errors, protection of patient data, medicolegal issues, need for provider training, insurance reimbursement, cost barriers and is not very useful in conditions which require an in-person visit.<sup>[45-49]</sup> In the COVID-19 era, telemedicine has an important role in patient screening and triage and also to manage post-operative issues without overwhelming the hospitals. The scheduled visits of follow up patients can be converted to scheduled video visits, wherever appropriate. The quarantined physicians can take up the telemedicine responsibility, freeing other practicing physicians for frontline response. The need of the hour therefore is to build a robust telemedicine infrastructure so that we not only deal with the COVID-19 but also be better prepared for future pandemics.

### The Education and Research Strategy

The education and training for lacrimal procedures is unique for subspecialty fellows of both ophthalmology and otorhinolaryngology.<sup>[50,51]</sup> COVID-19 pandemic has posed serious challenges to this training both in the clinics and operating rooms. Reports have demonstrated that teaching hospitals, for obvious reasons, have a longer operating times, longer hospital stays and greater utilization of health care resources.<sup>[27,52]</sup> In the COVID-19 times, these factors are to be delicately balanced with the need of education for residents and fellows. Clear communications defining specific roles of the faculty and fellows/residents are required.

To optimize the time away from the direct learning at the hospitals, online meeting platforms can be used for continuing the education and learning by virtual grand rounds and journal clubs.<sup>[53,54]</sup> Multicentric collaborative online educational programs can also to some extent compensate for the resident or fellow's reduction of clinical activity.<sup>[33]</sup> The significance of independent study cannot be overemphasized. This strategy could include problem-based learning, educational material, online lectures and question

banks. Surgical simulation for diagnostic and therapeutic endoscopy using certain specific head and neck models would help continue the training.<sup>[55]</sup> Regular internal and external assessments can be used as performance metrics.<sup>[56]</sup> The usual timelines for progress evaluation and exams should be made flexible. Remote conductance of exams and evaluation strategies with adequate time for its preparation is helpful. Allowing an extra month for the fellows to stay back for additional learning to make up for the COVID-19 loss can also be an option.

COVID-19 pandemic has offered a newfound time for both mentors and fellows to delve into research. Access to journal articles and educational material needs to be ensured. The access to clinical data or electronic medical records can play a crucial role in continuing research but needs to be carefully planned out with all efforts to safeguard the patient data. The teams can get together on virtual platforms regularly to discuss new ideas and the progress of existing projects with clearly defined goals for each member. Research would also include mentorship for fellowship guidance or career paths.<sup>[56]</sup>

The educational strategies should not be restricted to resident/fellows but also spread out for the other hospital staff, specially the OR staff. There need to be virtual programs or instructional videos and team huddles at defined intervals on hand-hygiene, donning and doffing of personal protective equipment and specifics of pre- and post-operative care of patients with lacrimal disorders. Organization of on-site drills with COVID-19 precautions to enhance the ability to respond to surge in surgical demand would go a long way in smooth conduct of procedures. Educational strategies should also target patients visiting the hospitals to enhance their awareness of all COVID-19 precautions that they are expected to comply with.

### The Psychosocial Strategy

The toll on the mental health of healthcare workers during COVID-19 is often overlooked. Pandemics are known to generate anxiety, stress and fear among frontline workers.<sup>[57-58]</sup> The psychological stress emanates from several factors namely the direct care of COVID-19 patients, uncertainty of the crisis, lack of vaccine and personal protection, societal view of suspicion of harboring infection, knowing someone who has COVID-19 or died of the disease, fear of taking the infection back home, separation from families or self-isolation, inadequate or misinformation, fear of financial loss, extended working hours, increased load of surgeries once the peak settles, lack of adequate rest, maintaining quality of care at all times compounded with constant need to be vigilant in keeping the patients and themselves safe.<sup>[57-60]</sup> All these factors can result in psychological distress, anxiety, depression, fatigue, along with subsequent judgment and decision errors.<sup>[27,61]</sup> Hence, it is crucial to develop stress and fatigue mitigation strategies now and would include a comprehensive approach of good pre-operative planning, taking regular short breaks, clear assignment of team roles, enhancing awareness, optimizing surgeon's sleep and nutrition, online engagement for psychosocial support and overall emphasis on altruism.<sup>[27,59,60]</sup> Furthermore, enhanced and clear team communication, sincere expression of gratitude to each other and elimination of silo-mentality goes a long way in improving

the OR efficiency,<sup>[27]</sup> and this cannot be emphasized more in times of a pandemic. Supporting healthcare workers on all fronts including psychosocial is critical for a sustainable healthcare delivery.

## Conclusion

The cancellation of all non-urgent and elective surgical procedures is currently being practiced since nearly 2-3 months. While this is important, prolong deferral can be detrimental with respect to patient morbidity, their quality of life and healthcare and economic fallout. Hence, there is a need to simultaneously formulate evidence-based strategies for a gradual and safe return to full lacrimal practice, and be ready to implement them when the time arrives. These recommendations do not and should not supersede the respective government guidelines. COVID-19 information is constantly getting updated at a rapid pace and the algorithms proposed in the current study can be a starting point for further alterations based on the evolving clinical and non-clinical needs. However, limitations of the current mitigation strategies, time for flattening of the infection curve, a possible second wave of disease resurgence and reinfections may further delay the resumption of lacrimal surgeries. Hence, the proposed strategies may need to be modified and may or may not be viable based on local government guidelines, individual and institutional discretions.

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### Conflicts of interest

There are no conflicts of interest.

## References

1. Ahn DG, Shin HJ, Kim MH, Lee S, Kim HS, Myoung J, *et al.* Current status of epidemiology, diagnosis, therapeutics, and vaccines for novel coronavirus disease 2019 (COVID-19). *J Microbiol Biotechnol* 2020;30:313-24.
2. Satiani B, Zigrang TA, Bailey-Wheaton JL. COVID-19 financial resources for physicians. *J Vasc Surg* 2020;S0741-5214 (20) 31079-X. doi: 10.1016/j.jvs. 2020.04.482.
3. New AHA report finds financial impact of COVID-19 on hospitals and health systems to be over \$200 billion through June. Available from: <https://www.aha.org/special-bulletin/2020-05-05-new-aha-report-finds-financial-impact-covid-19-hospitals-and-health>. [Last accessed on 2020 May 10].
4. Zou L, Ruan F, Huang M, Liang L, Huang H, Hong Z, *et al.* SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med* 2020;382:1177-9.
5. De Luca P, Scarpa A, Ralli M, De Vincentiis M, Cassandro E, Chiarella G, *et al.* Nasal, pharyngeal and laryngeal endoscopy procedures during COVID-19 pandemic: Available recommendations from national and international societies. *Eur Arch Otorhinolaryngol* 2020;1-3. doi: 10.1007/s00405-020-06028-1.
6. Ali MJ, Hegde R, Nair AG, Bajaj MS, Betharia SM, Bhattacharjee K, *et al.* AIOS-OPAI consensus statement on preferred practices in oculoplasty and lacrimal surgery during the COVID-19 pandemic. *Indian J Ophthalmol* 2020;68:974-80.
7. Van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, *et al.* Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N Engl J Med* 2020;382:1564-7.
8. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of

- coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *J Hosp Infect* 2020;104:246-51.
9. Pulia MS, O'Brien TP, Hou PC, *et al.* Multi-tiered screening and diagnosis strategy for COVID-19: A model for sustainable testing capacity in response to pandemic. *Ann Med* 2020;1-8. doi: 10.1080/07853890.2020.1763449.
  10. Wang Y, Kang H, Liu X, Tong Z. Asymptomatic cases with SARS-CoV-2 infection. *J Med Virol* 2020. doi: 10.1002/jmv. 25990.
  11. Udugama B, Kadhiresan P, Kozlowski HN, Malekjahani A, Osborne M, Li VYC, *et al.* Diagnosing COVID-19: The disease and tools for detection. *ACS Nano* 2020;14:3822-35.
  12. Corral JE, Hoogenboom SA, Kroner PT, Vazquez-Roque MI, Picco MF, Farraye FA, *et al.* COVID-19 polymerase chain reaction testing before endoscopy: An economic analysis. *Gastrointest Endosc* 2020. doi: 10.1016/j.gie. 2020.04.049.
  13. Yang Y, Yang M, Shen C, Wang F, Yuan J, Li J, *et al.* Evaluating the accuracy of different respiratory specimens in the laboratory diagnosis and monitoring the viral shedding of 2019-nCoV infections. *MedRxiv* 2020. doi: 10.1101/2020.02.11.20021493.
  14. Gupta S, Shahidi N, Gilroy N, Rex DK. A proposal for return to routine endoscopy during the COVID-19 pandemic. *Gastrointest Endosc* 2020:S0016-5107 (20) 34249-8. doi: 10.1016/j.gie. 2020.04.050.
  15. Li Z, Yi Y, Luo X, Xiong N, Liu Y, Li S, *et al.* Development and clinical application of a rapid IgM-IgG combined antibody test for SARS-CoV-2 infection diagnosis. *J Med Virol* 2020. doi: 10.1002/jmv. 25727.
  16. Salomao BC, Maluf-Filho F. COVID-19 pandemic: The long and difficult way back to work. *Gastrointest Endosc* 2020:S0016-5107 (20) 34251-6. doi: 10.1016/j.gie. 2020.04.051.
  17. Mick P, Murphy R. Aerosol-generating otolaryngology procedures and the need for enhanced PPE during the COVID-19 pandemic: A literature review. *J Otolaryngol Head Neck Surg* 2020;49:29.
  18. Workman AD, Welling DB, Carter BS, Curry WT, Holbrook EH, Gray ST, *et al.* Endonasal instrumentation and aerosolization risk in the era of COVID-19: Simulation, literature review, and proposed mitigation strategies. *Int Forum Allergy Rhinol* 2020. doi: 10.1002/alr. 22577.
  19. Thamboo A, Lea J, Sommer DD, Sowerby L, Abdalkhani A, Diamond C, *et al.* Clinical evidence-based review and recommendations of aerosol generating medical procedures in otolaryngology-head and neck surgery during the COVID-19 pandemic. *J Otolaryngol Head Neck Surg* 2020;49:28.
  20. Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: A systematic review. *PLoS One* 2012;7:e35797.
  21. Cui C, Yao Q, Zhang D, Zhao Y, Zhang K, Nisenbaum E, *et al.* Approaching otolaryngology patients during the COVID-19 pandemic. *Otolaryngol Head Neck Surg* 2020. doi: 10.1177/0194599820926144.
  22. World Health Organization. Shortage of personal protective equipment endangering health workers worldwide. Available from: <https://www.who.int/news-room/detail/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide>. [Last accessed on 2020 May 15].
  23. Jessop ZM, Dobbs TD, Ali SR, Combella E, Clancy R, Ibrahim N, *et al.* Personal protective equipment (PPE) for surgeons during COVID-19 Pandemic: A systematic review of availability, usage and rationing. *Br J Surg* 2020. doi: 10.1002/bjs. 11750.
  24. Suen LKP, Guo YP, Tong DWK, Leung PHM, Lung D, Ng MSP, *et al.* Self-contamination during doffing of personal protective equipment by healthcare workers to prevent Ebola transmission. *Antimicrob Resist Infect Control* 2018;7:157.
  25. O'Connor CM, Anoushiravani AA, DiCaprio MR, Leung PHM, Lung D, Ng MSP. Economic recovery after the COVID-19 Pandemic: Resuming elective orthopedic surgery and total joint arthroplasty. *J Arthroplasty* 2020. doi: 10.1016/j.arth. 2020.04.038.
  26. Gilat R, Haunschild ED, Tauro T, Cole BJ. Recommendation to optimize safety of elective surgical care while limiting the spread of COVID-19: Primum non nocere. *Arthrosc Sports Med Rehabil* 2020. doi: 10.1016/j.asmr. 2020.04.008.
  27. Zeegen EN, Yates AJ, Jeysevar DS. After the COVID-19 pandemic: Returning to normalcy or returning to a new normal. *J Arthroplasty* 2020. doi: 10.1016/j.asmr. 2020.04.008.
  28. Ali MJ, Naik MN. Image-guided dacryolocalization (IGDL) in traumatic secondary acquired lacrimal drainage obstructions (SALDO). *Ophthalmic Plast Reconstr Surg* 2015;31:406-9.
  29. Ali MJ, Naik MN. First intraoperative experience with three-dimensional (3D) high-definition (HD) nasal endoscopy for lacrimal surgeries. *Eur Arch Otorhinolaryngol* 2017;274:2161-4.
  30. Lu CW, Liu XF, Jia ZF. 2019-nCoV transmission through the ocular surface must not be ignored. *Lancet* 2020;395:e39.
  31. Seah IYJ, Anderson DE, Kang AE, Wang L, Rao P, Young BE, *et al.* Assessing viral shedding and infectivity of tears in coronavirus disease 2019 (COVID-19) patients. *Ophthalmology* 2020. doi: 10.1016/j.ophtha. 2020.03.026.
  32. Ali MJ. Coronavirus disease 2019 (COVID-19) pandemic and lacrimal practice: Diagnostic and therapeutic nasal endoscopy and dacryoendoscopy. *Ophthalmic Plast Reconstr Surg* 2020. doi: 10.1097/IOP. 0000000000001756.
  33. Vukkadala N, Qian ZJ, Holsinger FC, Patel ZM, Rosenthal E. COVID-19 and the otolaryngologist: Preliminary evidence-based review. *Laryngoscope* 2020. doi: 10.1097/IOP. 0000000000001756.
  34. Chisari E, Krueger CA, Barnes CL, Van Onsem S, Walter WL, Parvizi J. Prevention of infection and disruption of the pathogen transfer chain in elective surgery. *J Arthroplasty* 2020. doi: 10.1016/j.arth. 2020.04.049.
  35. Ong SWX, Tan YK, Chia PY, Lee TH, Ng OT, Wong MSY, *et al.* Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. *JAMA* 2020;323:1610-2.
  36. Patel ZM, Fernandez-Miranda J, Hwang PH, Nayak JV, Dodd R, Sajjadi H, *et al.* Letter: Precautions for endoscopic transnasal skull base surgery during the COVID-19 pandemic. *Neurosurgery* 2020. doi: 10.1093/neuros/nyaa125.
  37. Kawana R, Kitamura T, Nakagomi O, Matsumoto I, Arita M, Yoshihara N, *et al.* Inactivation of human viruses by povidone-iodine in comparison with other antiseptics. *Dermatology* 1997;195(Suppl 2):29-35.
  38. Kariwa H, Fujii N, Takshima I. Inactivation of SARS coronavirus by means of povidone-iodine, physical conditions and chemical reagents. *Dermatology* 2006;212(Suppl 1):119-23.
  39. Eggers M, Eickmann M, Zorn J. Rapid and effective virucidal activity of povidone-iodine products against Middle East respiratory syndrome coronavirus (MERS-CoV) and modified vaccinia virus Ankara (MVA). *Infect Dis Ther* 2015;4:491-501.
  40. Mady LJ, Kubik MW, Baddour K, Snyderman CH, Rowan NR. Consideration of povidone-iodine as a public health intervention for COVID-19: Utilization as a 'personal protective equipment' for frontline providers exposed in high risk head and neck and skull base oncology care. *Oral Oncol* 2020. doi: 10.1016/j.oraloncology. 2020.104724.
  41. Parhar HS, Tasche K, Brody RM, Weinstein GS, O'Malley BW Jr, Shanti RM, *et al.* Topical preparations to reduce SARS-CoV-2 aerosolization in head and neck mucosal surgery. *Head Neck* 2020;42:1268-72.

42. Pattanshetty S, Narayana A, Radhakrishnan R. Povidone-iodine gargle as a prophylactic intervention to interrupt the transmission of SARS-CoV-2. *Oral Dis* 2020. doi: 10.1111/odi. 13378.
43. Ali MJ. A surgical protocol to mitigate the SARS-CoV-2 transmission using multifocal povidone iodine (PVP-I) applications in lacrimal surgeries during COVID-19 pandemic. *Ophthalmic Plast Reconstr Surg* 2020. doi: 10.1097/IOP. 0000000000001746.
44. Lurie N, Carr BG. The role of telehealth in the medical response to disasters. *JAMA Intern Med* 2018;178:745-6.
45. Valentino LA, Skinner MW, Pipe S. The role of telemedicine in the delivery of healthcare in the COVID-19 pandemic. *Hemophilia* 2020. doi: 10.1111/hae. 14044.
46. Williams AM, Kalra G, Commiskey PW, Bowers EMR, Rudolph BR, Pitcher MD, *et al.* Ophthalmology practice during the coronavirus disease 2019 pandemic: The university of Pittsburgh experience in promoting clinic safety and embracing video visits. *Ophthalmol Ther* 2020;1-9. doi: 10.1007/s40123-020-00255-9.
47. Hollander JE, Carr BG. Virtually perfect? Telemedicine for Covid-19. *N Engl J Med* 2020;382:1679-81.
48. Portnoy J, Waller M, Elliott T. Telemedicine in the era of COVID-19. *J Allergy Clin Immunol Pract* 2020;8:1489-91.
49. Martinez KA, Rood M, Jhangiani N, Kou L, Rose S, Boissy A, *et al.* Patterns of use and correlates of patient satisfaction with a large nationwide direct consumer telemedicine service. *J Gen Intern Med* 2018;33:1768-73.
50. Ali MJ, Psaltis AJ, Murphy J, Wormald PJ. Outcomes in primary powered endoscopic dacryocystorhinostomy: Comparison between experienced versus less experienced surgeons. *Am J Rhinol Allergy* 2014;28:514-6.
51. Kamal S, Ali MJ, Nair AG. Outcomes of endoscopic dacryocystorhinostomy: Experience of a fellowship trainee at a tertiary care center. *Indian J Ophthalmol* 2016;64:648-53.
52. Lavernia CJ, Sierra RJ, Hernandez RA. The cost of teaching total knee arthroplasty surgery to orthopedic surgery residents. *Clin Orthop Relat Res* 2000;99:e107.
53. Palan J, Roberts V, Bloch B, Kulkarni A, Bhowal B, Dias J. The use of a virtual learning environment in promoting virtual journal clubs and case-based discussions in trauma and orthopedic postgraduate medical education: The Leicester experience. *J Bone Joint Surg Br* 2012;94:1170-5.
54. Park JS, El-Sayed IH, Young VN, Pletcher SD. Development of clinical care guidelines for faculty and residents in the ear of COVID-19. *Head Neck* 2020. doi: 10.1002/hed. 26225.
55. Ali MJ. Nasal anatomy using realistic anatomical models. In: *Atlas of Lacrimal Drainage Disorders*. Singapore: Springer Nature; 2018. p. 89-95.
56. Kogan M, Klein SE, Hannon CP, Nolte MT. Orthopaedic education during the COVID-19 pandemic. *J Am Acad Orthop Surg* 2020;28:e456-64.
57. Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, *et al.* Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open* 2020;3:e203976.
58. Styra R, Hawryluck L, Robinson S, Kasapinovic S, Fones C, Gold WL. Impact on health care workers employed in high-risk areas during the Toronto SARS outbreak. *J Psychosom Res* 2008;64:117-83.
59. Wu PE, Styra R, Gold WL. Mitigating the psychological effects of COVID-19 on health care workers. *CMAJ* 2020;192:E459-60.
60. Chen Q, Liang M, Li Y, Guo J, Fei D, Wang L, *et al.* Mental health care for medical staff in China during the COVID-19 outbreak. *Lancet Psychiatry* 2020;7:e15-6.
61. Janhofer DE, Lakhiani C, Song DH. Addressing surgeon fatigue: Current understanding and strategies for mitigation. *Plast Reconstr Surg* 2019;144:693e-9e.